

Neutron-capture elements in halo, thick-disk, and thin-disk stars. Strontium, yttrium, zirconium, cerium

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Abstract

We derived Sr, Y, Zr, and Ce abundances for a sample of 74 cool dwarfs and subgiants with iron abundances, $[\text{Fe}/\text{H}]$, between 0.25 and -2.43. These estimates were obtained using synthetic spectra, assuming local thermodynamic equilibrium (LTE) for Y, Zr, and Ce, allowing for non-LTE conditions for Sr. We used high-resolution ($\lambda/\Delta\lambda \approx 40\,000$ and $60\,000$) spectra with signal-to-noise ratios between 50 and 200. We find that the Zr/Y, Sr/Y, and Sr/Zr ratios for the halo stars are the same in a wide metallicity range ($-2.43 \leq [\text{Fe}/\text{H}] \leq -0.90$), within the errors, indicating a common origin for these elements at the epoch of halo formation. The Zr/Y ratios for thick-disk stars quickly decrease with increasing Ba abundance, indicating a lower rate of production of Zr compared to Y during active thick-disk formation. The thick-disk and halo stars display an increase in the $[\text{Zr}/\text{Ba}]$ ratio with decreasing Ba abundance and a correlation of the Zr and Eu overabundances relative to Ba. The evolutionary behavior of the abundance ratios found for the thick-disk and halo stars does not agree with current models for the Galaxy's chemical evolution. The abundance ratios of Y and Zr to Fe and Ba for thin-disk stars, as well as the abundance ratios within each group, are, on average, solar, though we note a slight decrease of Zr/Ba and Zr/Y with increasing Ba abundance. These results provide evidence for a dominance of asymptotic-giant-branch stars in the enrichment of the interstellar medium in heavy elements during the thin-disk epoch, in agreement with the predictions of the nucleosynthesis theory for the main s-process component. © 2007 Pleiades Publishing, Ltd.

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